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Bite device used with a panoramic X-ray device

Background of the invention

The invention relates to a system for correct positioning of a patient when the latter is X-rayed with a medical panoramic X-ray device.

Prior art

When recording a panoramic X-ray image, the tomography zone ideally runs through the alveolar ridge of the patient. In order to achieve a high degree of recording quality, it is necessary to bring these two elements, tomography zone and alveolar ridge, into the best possible spatial relationship. In the panoramic X-ray device, the tomography zone can be adjusted to the individual shape and position of the jaw of a patient within certain limits. The condition is, however, that these are known to the operator. In particular, knowledge of the following features is significant:

- the spatial orientation of the edge-to-edge occlusal plane (bite plane) relative to a reference point on the panoramic X-ray device; and
- the individual anatomic characteristics of the jaw: its size, shape, anomalies and the like.

Traditionally, the patient's head is fixed in position relative to the device for taking a panoramic radiograph by means of a patient's head positioner comprising a forehead pad and/or ear pads, a bite block, a nasion, or a chin pad. The necessary alignment of the head is usually achieved with the aid of optical lines projected onto the patient's head and depicting the Frankfurt horizontal and median planes. The Frankfurt horizontal plane runs through the

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right and left porion, the highest point of the meatus acusticus externus, and the orbital, which represents the lowest point of the osseous edge of the orbita. The projected median plane runs as a sagittal plane from the crown 5 of the head through the center of the nose to the chin. It assists symmetrical positioning of the head.

The position of the occlusal plane is not directly registered but only indirectly by way of the Frankfurt horizontal plane. To this end, the Frankfurt horizontal plane projected 10 onto the patient's head by the panoramic X-ray device and the incisal teeth in the edge-to-edge bite are used to derive the position of the occlusal plane. The correlation between the occlusal plane and the Frankfurt horizontal plane is generally acknowledged from an anatomical 15 standpoint, but positioning errors relative to the Frankfurt horizontal plane of the patient cannot be excluded.

In order to determine the individual size of the patient's jaw, a frontal diameter measurement may be carried out, if necessary. Derivation of the jaw size is not, however, sufficiently 20 reliable.

Neither has any reliable system been as yet developed for determining the shape of the alveolar arch or any anomalies of the jaw.

Present-day panoramic X-ray devices, therefore, offer only 25 a few modification options, since the operator could not in any case make use of such adjustment options due to insufficient knowledge of the individual form of a patient's jaw.

This forms the basis of the invention. It is an object of 30 the invention, as characterized in the claims, to provide a system for correct positioning of a patient for image re-

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cording using a medical panoramic X-ray device, which allows for simple and stable measurement and/or adjustment of the inclination of the occlusal plane of a patient.

Description of the invention

5 This object is achieved, according to the invention, by the bite device defined in claim 1. Advantageous embodiments of the invention are subject matter of the sub-claims.

The invention improves on the prior art in that a bite device includes a holding member held in a directionally 10 fixed position relative to the X-ray device, and a plate which is pivoted relative to the holding member and which has a bite piece on which the patient bites. The bite device also includes means for measuring the angle of deflection α between the plate and the holding member, which 15 means for measuring the angle of deflection α are located in a zone of the bite device which is free from radiation during X-ray imaging. The zone involving X-ray irradiation can therefore be kept substantially free from metal.

The invention is thus based on the idea of measuring the 20 position of the occlusal plane of the patient relative to the device by determining the position of a plate disposed in the occlusal plane. For this purpose, the angle is measured between the plate and a holding member, which can be positioned relative to the X-ray device in fixed alignment. 25 From this angle a signal can be derived which indicates the degree of inclination of the occlusal plane.

It is advantageous for the means for measuring the angle of deflection α to contain one or more sensors located in the holding member. For example, the sensors might be in the 30 form of a photoelectric sensor located in the holding member and adapted to register the position of an opening that

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is moved upwardly and downwardly in accordance with the pivotal motion of the plate.

The bite device of the invention can conveniently include means for displaying the angular position of the pivoted 5 plate.

In a preferred development of the bite device, there are further provided driving means for vertical adjustment of the holding member and thus for pivoting the plate into a predetermined angular position. This makes it possible to 10 adapt to the patient's body size, and the patient can be constrained to adjust the inclination of his head to the inclination of the plate, so that a desired angular position of the patient's occlusal plane relative to the X-ray device will be achieved.

15 It is advantageous for the plate-swinging means to move the plate to the predetermined angular position automatically and to stop when the predetermined angular position has been reached.

Alternatively or additionally, provision may be made for 20 said means to indicate that the predetermined angular position of the plate has been reached by emitting optical and/or acoustic signals.

In a preferred embodiment of the bite device of the invention, the pivoted plate is connected to a rail within the 25 holding member, which rail can be moved upwardly and downwardly and has an opening for indicating the position of the rail in the holding member.

The bite piece of the bite device is preferably equipped with a replaceable protective sheath for hygienic reasons.

30 Alternatively, the bite piece can be in the form of a replaceable bite piece. The bite piece is preferably composed

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of a soft material, particularly a substantially radiolucent material. It has proved to be particularly suitable to fabricate the bite piece from closed-cell ethylene foam.

The bite piece preferably occupies an angular range β of the mandibular arch, which is between 20° and 40° , particularly 30° . This substantially prevents any sideways tipping or tilting of the patient's head.

In an advantageous embodiment, the bite piece has on its upper surface and on its undersurface a bite groove to accommodate part of the dental arch of the patient's upper and lower jaw respectively.

The bite piece is preferably a unitary piece foldable about a folding edge. It preferably has on opposite sides a wedge-shaped projection and a complementary depression for the accommodation of said projection, to enable the bite piece to be removably attached to the pivoted plate.

Further advantageous embodiments, features, and details of the invention are given in the dependent claims, the description of embodiments, and the drawings.

20 Brief description of the drawings

The invention will now be explained in more detail with reference to an embodiment and the drawings. Only those elements are shown which are significant for comprehension of the invention.

25 In the drawings:

Fig. 1 is a diagrammatic illustration of a panoramic X-ray system;

Fig. 2 is a diagrammatic representation of the system for aligning the tomography zone of the X-ray de-

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Fig. 3 shows a perspective view of a bite device according to one embodiment of the invention, shown diagrammatically;

Fig. 4 is a cross-section through the bite device of
5 Fig. 3;

Fig. 5 shows perspective views of an bite piece for a
bite device according to one embodiment of the
invention, shown (unfolded) diagonally from below
in Fig. 5(a) and diagonally from above in Fig.
10 5 (b);

Fig. 6 is a cross-section through the bite piece of Fig.
5, taken along line VI-VI; and

Fig. 7 shows the bite piece of Fig. 5 in the folded po-
sition, as attached to the bite device of Fig. 3.

15 Description of Embodiments

Fig. 1 is a diagrammatic representation of a panoramic X-ray system 10, in which a rotary unit 12 carries a radia-
tion source 14 equipped with a shutter 16, and a dia-
metrically opposed detector camera 18 equipped with a shut-
20 ter 20. The beam of X-rays 22 emitted from the radiation
source 14 transilluminates the jaw region of the head 24 of
a patient and produces an image signal in detector camera
18. This is directed to a control unit 26 for evaluation
and display in the usual manner.

25 Rotary unit 12 is pivotally or hingedly mounted on an arm
11 which is mounted on a column 13 for vertical adjustable
thereon. A drive 15 is provided to perform the vertical ad-
justment. In this way, the position of X-ray emitter 14 and
30 detector camera 18 can be adjusted to the stature of the
patient. It is essential, for obtaining a faultless, high-
quality panoramic radiograph, for the tomography zone 30

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(Fig. 2) to be in line with the alveolar arch 32 of the patient. Fig. 2 depicts perfect spatial alignment of these two elements, this ensuring the production of a qualitatively good image. Insufficient alignment can necessitate a 5 repeat radiograph, resulting in increased X-irradiation of the patient and additional expense in terms of material and time.

Fig. 3 is a perspective view of a bite device referenced as 10 40, according to one embodiment of the invention, shown diagrammatically, and Fig. 4 is a cross-section through the bite device 40 of Fig. 3. Bite device 40 has a holder 42 which is hinged to a thin plate 46 by means of a pivot 44. The thin plate 46 is adjoined, at its end remote from pivot 44, by an imaging zone 48 parallel to said thin plate.

15 The imaging zone 48 has an opening 62 by means of which, in a manner to be described in more detail below, a replaceable bite piece 50 can be quickly and easily attached to the thin plate. On its upper surface and on its undersurface, bite piece 50 has occlusal grooves 64 and 66 respectively, which accommodate the dental arches of the patient's upper and lower jaw respectively. This arrangement ensures that the thin plate 46 runs parallel to the occlusal plane of the patient when he bites on the bite piece 50 for taking the radiograph.

20 25 The angle of deflection α of thin plate 46 is measured using a rail 54 capable of being moved upwardly and downwardly and connected to thin plate 46 in a region 56, and adapted to extend vertically down the inside 52 of the holding member 42. In its lower section, rail 54 is provided with a hole 58. The vertical position of hole 58 is detected by two photodetectors indicated by arrows 60. The angle of deflection of plate 46 can be deduced from said 30

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vertical position. By transferring the inclination of plate 46 to the movable rail, measurement of the angle of deflection α is carried out in a region of holder 42 which is far below plate 46 and is free from radiation. The X-irradiated 5 region can thus be kept substantially free from metal.

The bite device cooperates with a driving system 15 shown in Fig. 1 such that rail 54 moves upwardly or downwardly and the thin plate 46 can thus be brought into any desired position. The deflection of thin plate 46 accompanying such 10 vertical adjustment makes it possible to gently guide the patient's head until it assumes the correct degree of inclination for the panoramic radiograph.

Vertical adjustment of plate 46 can be performed interactively by the operator. For example, the operator can press 15 an adjustment button until the desired degree of inclination is attained. When a previously defined angular position, for example $\alpha = 105^\circ$, which corresponds to an angle between plate 46 and the horizontal of 15° , is attained, this can be indicated by means of optical and/or acoustic 20 signals.

Alternatively, the drive can automatically move plate 46 into the predetermined angular position and stop when the desired position is reached. Additionally, the angular position of the plate can be displayed for checking by the 25 operator.

The bite piece 50 shown in Figures 3 and 4 will now be described in more detail with reference to Figures 5 through 7. Fig. 5 shows, in Fig. 5(a) and Fig. 5(b), a perspective view of the unfolded insert, shown diagonally from below in 30 Fig. 5(a) and diagonally from above in Fig. 5(b). Figure 6 shows a cross-section through the bite piece taken along line VI-VI of Fig. 5(b), and Fig. 7 represents the bite

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piece in the folded position, as attached to the bite device of Fig. 3.

In the present embodiment, bite piece 50 is fabricated as a single piece of closed-cell ethylene foam, a soft and substantially radiolucent material. On its upper surface, bite piece 50 has occlusal grooves 64 and 66 adapted to accommodate part of the dental arch of the upper and lower jaws of the patient. Bite piece 50 can be folded along a central folding edge 70, defined by notches 72 on the undersurface 10 and a central groove 74 on the upper surface of the insert.

On its underside, bite piece 50 has a wedge-like tapered projection 76 which, when the insert is folded, slides into a complementary depression 78 located on the opposite side of the insert, this making for a stable but easily releasable connection. The flat imaging zone 48 of the bite device contains an opening 62 (Fig. 4) through which the projection 76 projects when the bite insert is attached, so that insert 50 is firmly attached to the thin plate 46 of the bite device once it has been folded together. After 20 use, however, the insert can be unfolded with no great effort and thrown away for hygienic reasons.

The insert shown in the embodiment illustrated in Figures 5 through 7, has a width of 40 mm, occupies an angular region β of the dental arch of about 30° . In order to accommodate 25 for different jaw sizes of patients, bite pieces are also fabricated and used in other widths. The different widths can be easily distinguished by the user on the basis of different color markings or other labels. With this kind of bite piece, the position of the patient can be fixed with 30 great accuracy but without discomfort for the patient.

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List of reference numerals or characters

- 10 radiographic system
- 12 unit
- 14 source of radiation
- 5 15 driving system
- 16 shutter
- 18 detector camera
- 20 shutter
- 22 beam of X-rays
- 10 24 head
- 26 evaluation unit
- 30 tomography zone
- 32 alveolar arch
- 40 occlusal device
- 15 42 holder
- 44 pivot
- 46 plate
- 48 imaging zone
- 50 bite piece
- 20 52 interior of holding member 42
- 54 rail
- 56 region
- 58 hole
- 60 arrows
- 25 62 opening

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64 occlusal groove

66 occlusal groove

70 folding edge

72 notches

5 74 central groove

76 projection

78 depression